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Accident Study and Improvement Plan



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FEBRUARY 1984

Clete Daily and Associates - Engineers, Planners
Helena, Montana

DAWSON COUNTY ACCIDENT STUDY
AND IMPROVEMENT PLAN

Prepared For:

MONTANA ASSOCIATION OF COUNTIES

In Cooperation With

MONTANA DEPARTMENT OF JUSTICE,
HIGHWAY TRAFFIC SAFETY DIVISION

Prepared By:

CLETE DAILY AND ASSOCIATES
524 West Lawrence
Helena, Montana

February, 1984



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TABLE OF CONTENTS

	<u>Page</u>
CHAPTER I: INTRODUCTION	1
A. Purpose.	1
B. County Road Accident History	1
C. County Accident Locations.	4
CHAPTER II: STUDY METHODS.	6
A. Accident Analysis.	6
B. Preliminary Field Survey	6
C. Detailed Field Survey.	6
D. Calculate Hazard Index	10
E. Develop Recommended Improvement Plans.	17
F. Cost Estimates	17
G. Calculate Priority Index	17
H. Benefit/Cost Analysis.	18
CHAPTER III: SUMMARY OF RECOMMENDATIONS	19
A. Improvement Priorities	19
B. Implementation	19
C. On-Going Program	21
D. Funding Sources.	22
CHAPTER IV: SITE ANALYSIS	24

LIST OF TABLES

<u>Table No.</u>	<u>Content</u>	<u>Page</u>
1	Dawson County vs. Montana County Road System Accident Comparison, 1979-82.	2
2	Comparison of Dawson County Accidents to Adjacent Counties, 1979-82.	3
3	Relative Severity Index	15
4	Improvement Priority List	20

LIST OF FIGURES

<u>Figure No.</u>	<u>Content</u>	<u>Page</u>
1	Driver Expectancy Problems Rating Form.	8
2	Information System Deficiencies Rating Form . . .	9
3	Indicator Values for Number of Accidents.	11
4	Indicator Values for Accident Rate.	11
5	Indicator Value for Accident Severity	12
6	Indicator Values for V/C Ratio.	12
7	Indicator Values for Sight Distance	13
8	Indicator Values for Driver Expectancy.	13
9	Indicator Values for Information System Deficiencies.	14
10	Form for Determination of Cost Factor	14

CHAPTER I

INTRODUCTION

A. Purpose

The purpose of this report is to analyze the cause of accidents at locations on the county road system where accident reports indicate a cluster of accidents, and to develop an improvement plan for those locations.

B. County Road Accident History

The Dawson County road system has 1,381 miles of road, of which 1,292 miles are dirt or gravel surfaced and 89 miles are paved. The average road mileage for the 56 counties in the state is 1,219 miles with an average of 1,105 miles per county dirt or gravel surfaced and 114 miles paved.

During the four-year period from January 1979 through December 1982, 124 reported accidents occurred on the Dawson County road system.

Accident rates are normally expressed in terms of number of vehicle miles traveled, generally the rate indicates the number of accidents per million vehicle miles of travel over a particular roadway. There are not sufficient traffic counts available on the county road system to estimate vehicle miles of travel, however, a comparison has been made of the number of accidents per capita and the number of accidents per mile of road. Compared to other counties in the state, Dawson County ranks 49th in accidents per capita based on the 1980 county population and 27th in accidents per mile of county road.

Table 1 shows the total annual accidents on the county road system and the annual number of accidents on county roads statewide.

TABLE 1

DAWSON COUNTY VS. MONTANA COUNTY ROAD
SYSTEM ACCIDENT COMPARISON, 1979-1982

	<u>County</u>	<u>Percent of State</u>	<u>Montana</u>
Population	11,805	1.5%	786,690
County Road Mileage	1,381	2.0%	68,240
Total Accidents on County Roads	124	1.0%	12,466
Annual Property Damage and Injury Accidents			
1979	26	0.8%	3,374
1980	24	0.8%	3,129
1981	46	1.5%	3,085
1982	27	1.0%	2,740
Total	123	1.0%	12,328
Fatal Accidents, 1979-1982	1	0.7%	138
Accidents Per Capita	.011	*	.016
Accidents Per Road Mile	.090	*	.183

* Not Applicable

TABLE 2

COMPARISON OF DAWSON COUNTY ACCIDENTS TO
ADJACENT COUNTIES, 1979-1982

<u>County</u>	<u>Statewide Rank</u>	
	<u>Accidents/Capita</u>	<u>Accidents/Road Mile</u>
DAWSON	49th	27th
Richland	36th	18th
McCone	27th	52nd
Prairie	11th	41st
Wibaux	1st	26th

Table 2 shows a comparison of accidents per capita and per mile of county road for Dawson County and the adjacent counties.

Dawson County has 13 percent more county road mileage than the average county in the state. The county also had 31 percent less accidents on county roads, per person residing in the county. Dawson County has less than half as many accidents per road mile than the average county in the state. This may be due to more miles of road with lower traffic volumes. Other factors that could contribute to this lower accident rate are driver characteristics, road design and maintenance, terrain, weather conditions, and enforcement. Dawson County ranks 47th in accidents per capita and 27th in accidents per road mile when compared to the other 55 counties in the state. Compared to the four adjacent counties, Dawson County ranks fifth in accidents per capita and third in accidents per road mile.

C. County Accident Locations

The Department of Justice maintains computer records of all reported accidents in the state. These are plotted on county maps, annually. The Highway Traffic Safety Division of the Department of Justice has carried out a number of projects where improvements were recommended at locations showing a concentration of accidents. The short-term improvements have been found to be effective in reducing accidents at specific locations. In 1979, Gallatin County implemented recommended short-term improvements at 19 high accident locations. The result was a reduction from an average of 16 accidents per year in 1979 to an average of six accidents at each site in 1980. The total cost of the engineering analysis and improvements was \$22,000. Based on an average estimated cost of \$6,800 per accident and a five-year life for the improvements, the resulting users savings was \$15 for every \$1 of safety improvement funds expended.

Five locations in Dawson County were found to have clusters of accidents that would warrant a detailed investigation. The sites selected are:

<u>Site Number</u>	<u>Location</u>
1	Curve on Dry Creek Road 0.75 miles northeast of Montana Highway 200 South
2	Curves on Dry Creek Road 2.2 road miles from the intersection of Montana Highway 200 South
3	Seven Mile Road overpass at Interstate 94
4	Intersection of Michelle Lane and U.S. Highway 94 Business Route
5	Cutbacks on Makoshika State Park Road

The locations are shown on the Site Location Map at the beginning of Chapter IV.

CHAPTER II

STUDY METHODS

The determination of improvements required to reduce accidents at the selected sites involves eight basic steps. These are outlined in the following sections.

A. Accident Analysis

Department of Justice microfilm records were used to obtain the accident reports of accidents at each of the selected sites. The accident reports were reviewed and pertinent information was plotted on a preliminary sketch of each location. This information included: a symbolic sketch showing vehicle paths, point of collision, collision type, time of day, road condition and number of injuries or fatalities. The sketches were used to determine trends and patterns.

B. Preliminary Field Survey

The Highway Traffic Safety Division, Traffic Engineer, and the consultant visited each site to determine the specific area to be covered by the detailed field survey. The Valley County road superintendent was also contacted and the characteristics of each site including planning improvements were reviewed. Each site was photographed and general characteristics were noted.

C. Detailed Field Survey

A two-man survey crew revisited each site to collect detailed data. The following information was collected;

1. Site Survey -- Each site was surveyed so that an accurate plan of the site could be prepared, showing roadway alignment, grades, superelevations and other physical characteristics. Surrounding topography was also surveyed showing sign and

other traffic control device locations, fences, utility poles, trees and other roadside objects. The survey was extended to take in all features which could have an effect on the road-user such as background roads that appear to be an extension of the roadway or utility lines or waterways which continue straight while the roadway turns. These features sometimes create driver expectancy resulting in off-road accidents.

2. Traffic Counts -- All available count data for each site was obtained from the Montana Department of Highways. In locations where counts were not available, peak hour counts were made and were used to estimate average daily traffic. Some sites are subject to extreme seasonal traffic variations. At these sites, housing counts along with other land uses were used to estimate average daily traffic.¹
3. Sight Distance -- The driver sight distance on all approaches at each site was measured.
4. Safe Speed Study -- A ball-bank indicator was used to determine the safe speed on horizontal curves. This instrument measures the overturning force on a vehicle and limits at which riding discomfort and loss of vehicle control begin.
5. Driver Expectancy and Information System Evaluation -- Each member of the survey crew independently rated the driver expectancy and informational system of each site.

The driver expectancy rating is a measure of a driver's perception of the roadway and the amount of time a driver has to react and take the necessary actions to pass safely through the location. The rating ranges from no unexpected or unusual actions required to very unusual situations which would surprise many unfamiliar drivers.

The information system evaluation consisted of determining if the roadway and traffic control devices were sufficient to give the driver the information required in sufficient time to take the necessary actions to safely negotiate the location. Ratings for the information system range from easy and obvious information interpretation to the lack of important information.

The evaluation forms used for the driver expectancy and information system evaluation are shown in Figures 1 and 2.

¹
ADT

Figure 1

DRIVER EXPECTANCY PROBLEMS RATING FORM

Ratings

- 0 -- Nothing expected or unusual at this location.
 Actions required (if any) entirely consistent with driving strategy on approach.
 Standard geometry, with pathway(s) for intended movement(s) clearly evident.
 No interferences by other traffic likely.
- 1 --
- 2 --
- 3 -- Situation somewhat unexpected.
 Driver must be alert, but should be able to respond adequately at "last minute" to most combinations or adverse circumstances.
 Some initial confusion on intended path(s) or movements(s).
 Interference from other traffic may create some degree of confusion or uncertainty for average driver.
- 4 --
- 5 --
- 6 -- Very unusual situation; will "surprise" many unfamiliar drivers.
 Driver required to make major change in driving tactics from those employed over past few miles.
 At least a "near accident" almost expected if driver is even moderately inattentive; evasive actions likely to be required.
 Intended pathway(s) confusing under fairly normal traffic or lighting conditions.
 Other traffic, or lack of it, aggravates situation and misleads driver or deprives him of important cues.

Approach

	0	1	2	<u>Rating</u> 3	4	5	6
A	x-----x-----x-----x-----x-----x-----x						
B	x-----x-----x-----x-----x-----x-----x						
C	x-----x-----x-----x-----x-----x-----x						
D	x-----x-----x-----x-----x-----x-----x						

Source: Identification of Hazardous Locations, Report No. FHWA-RD-77-83

Figure 2

INFORMATION SYSTEM DEFICIENCIES RATING FORM

Ratings

- 0 -- Information for required decisions complete and ambiguous.
Signs, markings, delineation in good repair, clean, highly visible.
"Positive guidance" leads driver to appropriate path; makes error difficult.
Approach speeds of most drivers are appropriate.
Light decision load; easy, and obvious.
- 1 --
- 2 --
- 3 -- Some information lacking or somewhat misleading.
Signs should be moved or augmented for better visibility or to provide more decision time.
Visibility of signs, markings, and delineation barely adequate.
Advisory speed information should be changed slightly, or added.
Medium decision load; average driver will be able to handle situation, but may be a little uncomfortable.
- 4 --
- 5 --
- 6 -- Important information missing.
Complete new "information system" needed -- design and installation.
Present signs and markings in very poor condition; need replacement.
Speed limit and/or advisory speed needed; either missing or totally inappropriate at present.
"Positive guidance" on appropriate path lacking; a clutter of negative delineation only.
Heavy decision load; complete attention of average driver required; a "tense" situation at best.

Approach

	<u>Rating</u>						
	0	1	2	3	4	5	6
A	x-----x-----x-----x-----x-----x-----x						
B	x-----x-----x-----x-----x-----x-----x						
C	x-----x-----x-----x-----x-----x-----x						
D	x-----x-----x-----x-----x-----x-----x						

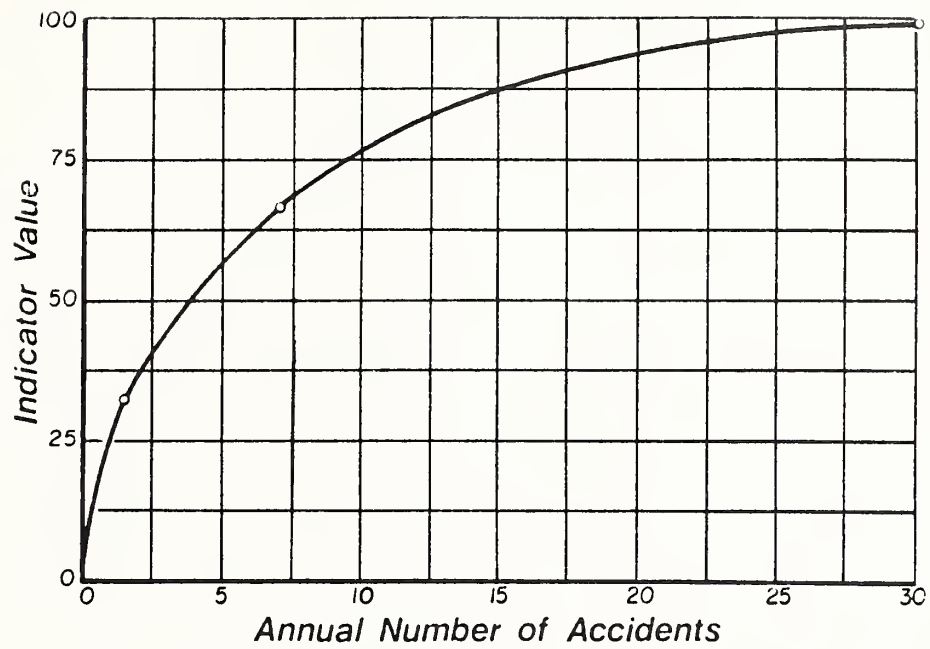
Source: Identification of Hazardous Locations, Report No. FHWA-RD-77-83

6. Site Sketches -- The field survey data was used to prepare a sketch of each site showing the pertinent features. These include alignment, grade, roadway dimensions, approaches, ditches, foliage, roadside objects, traffic control devices, surface type and condition, sight distance and surrounding features that may affect the function of the roadway. The sketches have been used as a base to show the existing conditions, accident diagrams and recommended improvements contained in the site analysis section of this report (Chapter IV).

D. Calculate Hazard Index

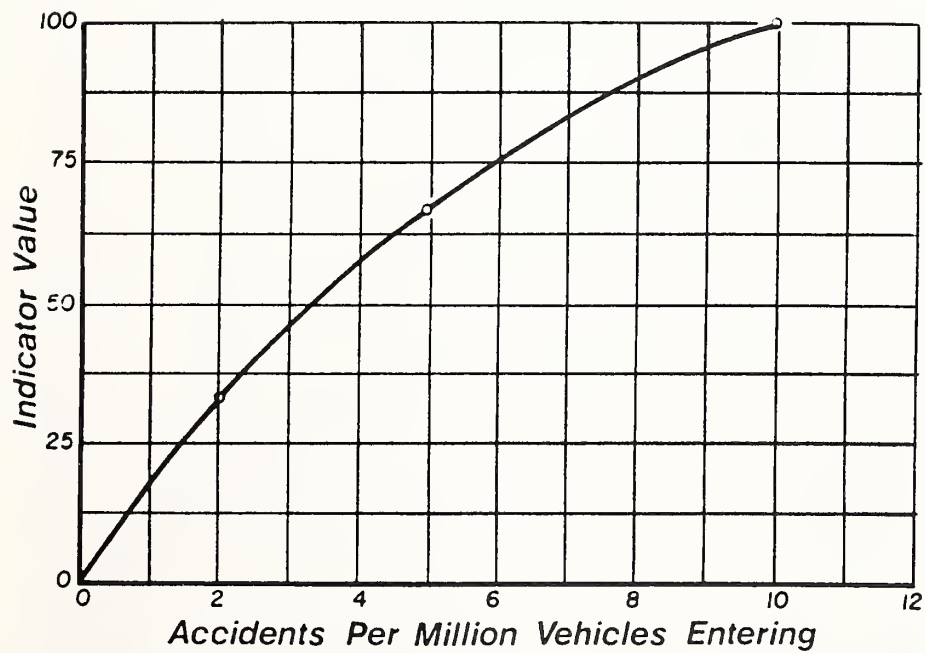
A hazard index was calculated for each site. The hazard index calculations form along with the various indicator values are shown in Figures 3 through 10. The factors entering into the hazard index calculation are as follows:

- Number of Accidents -- The average annual number of accidents for the four-year period from 1979 through 1982 was used to calculate this indicator (see Figure 3).
- Accident Rate -- The accident rate is expressed in accidents per million vehicle miles of travel. The average daily traffic (ADT) as determined from Montana Department of Highways traffic counts, and estimated ADT based on peak hour counts or land use, were used to compute this indicator (see Figure 4).
- Accident Severity -- Accident severity relates property damages, bodily injuries and fatalities to dollar costs. The unit costs shown in Figure 4 were used to calculate this indicator (see Figure 5 and Table 3).
- Volume/Capacity Ratio -- The 1983 average daily traffic and the 24-hour capacity (Level of Service) as calculated using the methods set forth in the 1965 Highway Capacity Manual, were used to calculate this indicator (see Figure 6).
- Sight Distance -- Sight distances on all approaches were determined by the field survey. This was related to the required stopping distance to determine the indicator value of each location (see Figure 7).
- Driver Expectancy Problems and Information System Deficiencies -- The average rating values from the two independent field ratings were used to determine the values for these two indicators (see Figures 1, 2, 8, and 9).



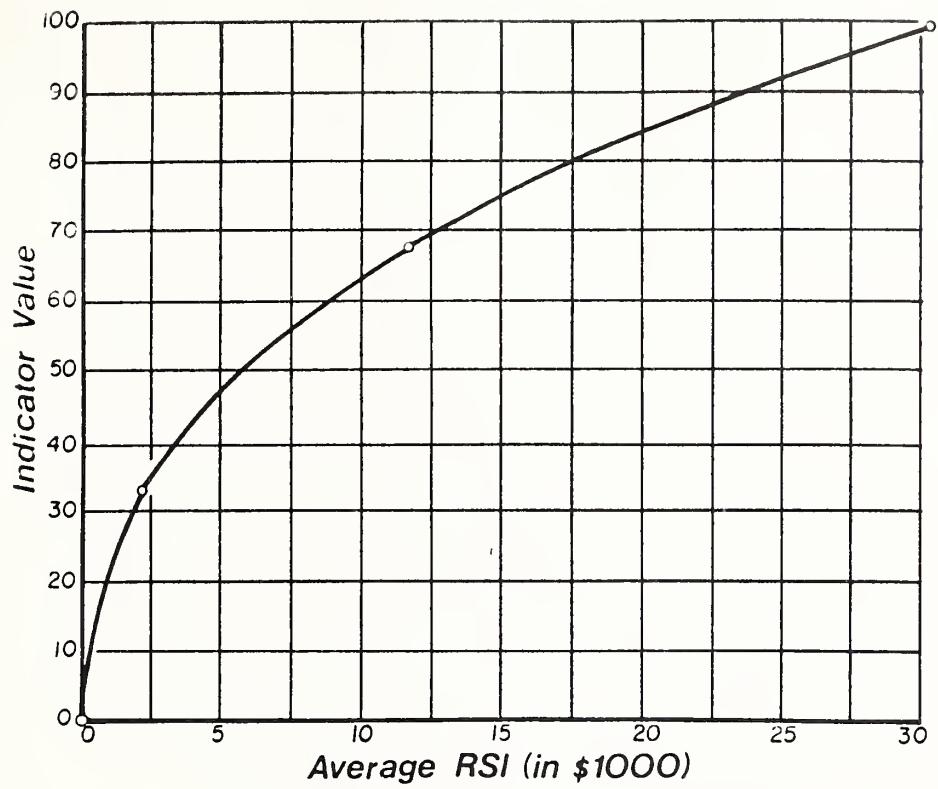
**INDICATOR VALUES FOR NUMBER
OF ACCIDENTS**

Figure 3



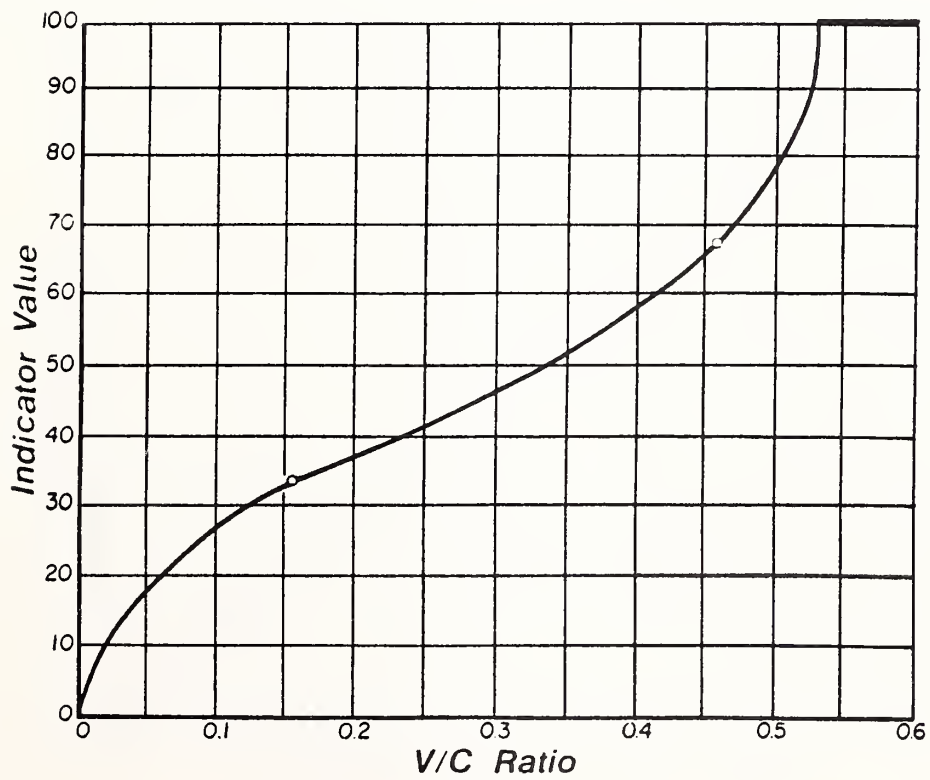
**INDICATOR VALUES FOR
ACCIDENT RATE**

Figure 4



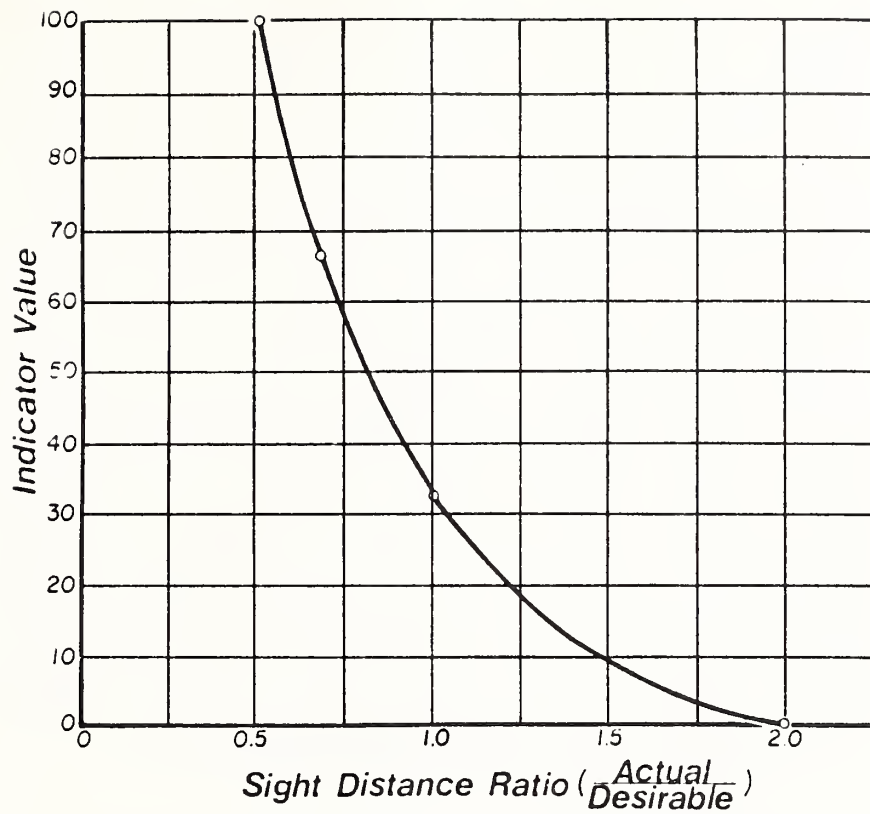
**INDICATOR VALUE FOR
ACCIDENT SEVERITY**

Figure 5



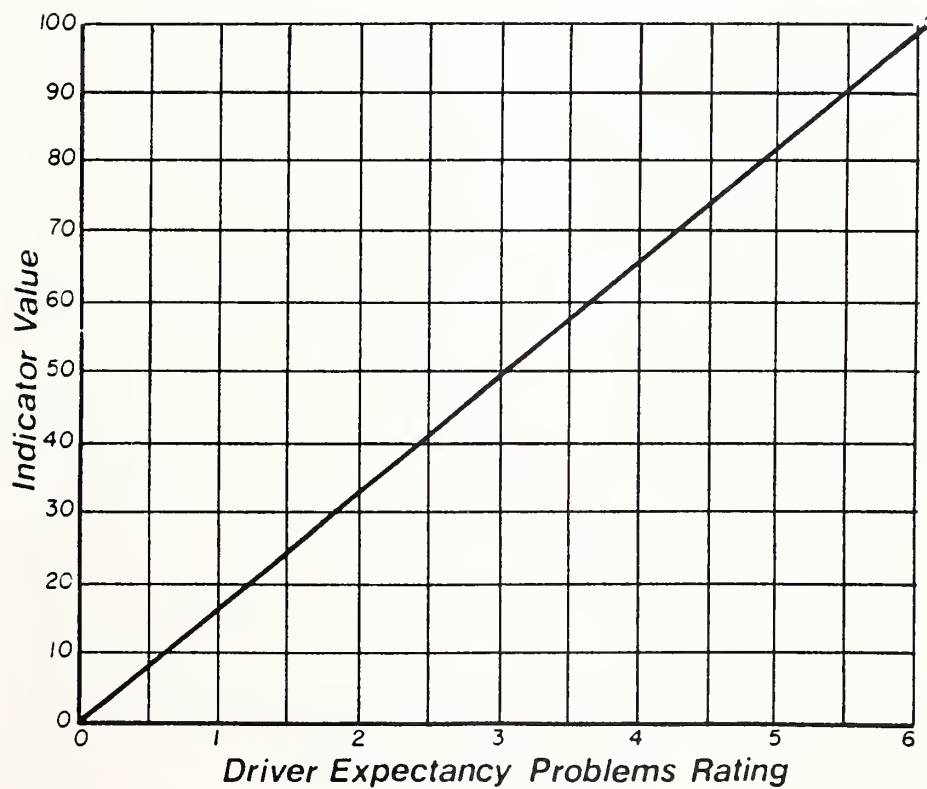
**INDICATOR VALUES FOR
V/C RATIO**

Figure 6



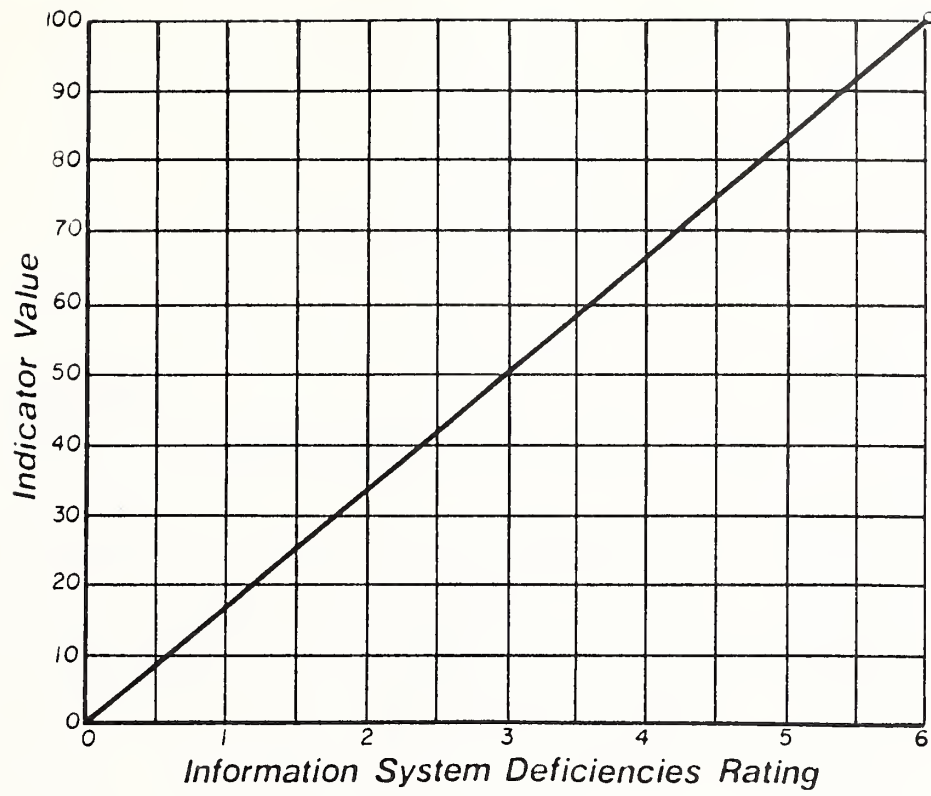
INDICATOR VALUES FOR
SIGHT DISTANCE

Figure 7



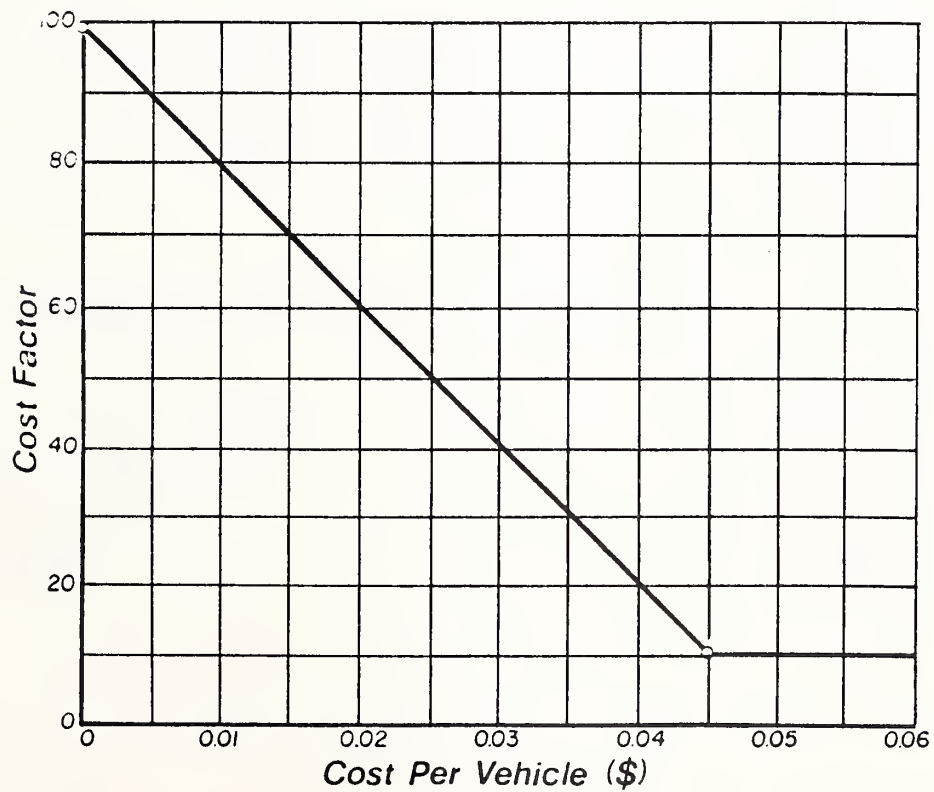
INDICATOR VALUES FOR
DRIVER EXPECTANCY

Figure 8



**INDICATOR VALUES FOR INFORMATION
SYSTEM DEFICIENCIES**

Figure 9



**FORM FOR DETERMINATION
OF COST FACTOR**

Figure 10

TABLE 3
RELATIVE SEVERITY INDEX

<u>TYPE OF ACCIDENT</u>	<u>Urban</u>	<u>RSI</u>	<u>Rural</u>
<u>Multi-Vehicle, At Intersection</u>			
Enter at angle	\$ 4,300		\$14,400
From same direction - both going straight	2,800		5,100
From same direction - one turn, one straight	2,500		5,100
From same direction - one stopped	3,800		5,200
From same direction - all others	2,000		6,300
From opposite direction - both going straight	4,400		20,000
From opposite direction - one left turn, one straight	4,400		15,400
From opposite directions - all others	2,700		3,800
Not stated	3,800		5,200
<u>Multi-Vehicle, Non-Intersection</u>			
Going opposite direction - both moving	\$ 4,400		\$19,600
Going same direction - both moving	2,900		8,100
One car parked	1,600		2,400
One car stopped in traffic	4,200		6,800
One car entering parked position	1,900		2,300
One car leaving parked position	1,200		2,700
One car entering alley or driveway	3,400		6,000
One car leaving alley or driveway	2,000		4,400
All others	1,700		7,600
Not stated	3,400		6,000
<u>Motor Vehicle with Pedestrian, At Intersection and Non-Intersection</u>			
Vehicle going straight	\$20,000		\$49,000
Vehicle turning right	13,600		11,200
Vehicle turning left	17,100		11,200
Vehicle backing	20,600		11,200
All others	14,500		11,200
Not stated	11,200		11,200

TABLE 3

RELATIVE SEVERITY INDEX (Continued)

<u>TYPE OF ACCIDENT</u>	<u>Urban</u>	<u>RSI</u> <u>Rural</u>
<u>Single Vehicle, at Intersection</u>		
Collision with train	\$26,700	\$39,100
Collision with bicycle	13,100	31,900
Injury in vehicle, jackknifed	5,200	2,000
Collision with fixed object in road	5,500	7,000
Overtuned in road	9,200	7,500
Left road	5,200	12,300
<u>Single Vehicle, Non-Intersection</u>		
Collision with train	\$26,700	\$39,100
Collision with bicycle	13,100	31,900
Injury in vehicle, jackknifed	5,200	2,000
Collision with fixed object in road	6,300	9,200
Overtuned in road	10,000	9,400
Left road at curve	7,600	12,400
Left road on straight road	5,200	10,500
<u>Other One Motor Vehicle, At Intersection and Non-Intersection</u>		
Fell from moving vehicle	\$15,000	\$57,200
Collision with animal	4,800	1,800
Collision with other object	4,700	4,400
All others	5,200	2,000
Not stated	3,200	3,400

Source: National Safety Council

- Hazard Index -- The hazard index for each site was calculated by combining the seven hazard rating indices. The hazardness of each location was used to rank the sites.

E. Develop Recommended Improvement Plans

A recommended improvement plan has been developed based on the layout sketch, accident analysis, field notes, traffic volumes and movements, photos, site inspections and local interviews. The improvements are shown on the location sketch for each site contained in Chapter IV.

Recommended improvements have been separated into two categories:

1. Short range improvements which consist of traffic control and minor geometric modifications.
2. Long range improvements including items such as major changes in alignment, reconstruction, new construction or recommendations related to future development in the area.

F. Cost Estimates

The cost estimates of the proposed improvements are based on recent bid prices for similiar projects. The costs are based on contract prices even through most of the short-term improvements can be accomplished by the county maintenance crew.

The estimated costs are used to determine the cost factor which is the improvement cost per vehicle entering the site over a five-year period. The five-year period represents the reasonable design life of the improvements.

Figure 10 is used to determine the cost factor for each site.

G. Calculate Priority Index

The priority index is determined by combining the hazard index and the cost index. The hazard index is given a 75 percent weight and the

cost index is weighted 25 percent. These calculations are shown in Chapter IV. The priority index is used to rank each site as shown in the priority listing in Chapter III.

H. Benefit/Cost Analysis

The Montana Department of Highways calculates the Benefit/Cost ratio of safety improvements in order to set priorities for on-system projects. It is possible that in the future, state or federal funds may be made available for off-system improvements. In anticipation of this possibility, the Benefit/Cost ratio for each site has been calculated using the MDOH method.

CHAPTER III

SUMMARY OF RECOMMENDATIONS

A. Improvement Priorities

Table 4 shows the final listing of improvement priorities based on the priority index which takes into account the hazardousness of each site and the cost of recommended improvements. The hazard index is given a 75 percent weight and the cost factor a 25 percent weight.

The Benefit/Cost ratio calculated using the Montana Department of Highway's method, is also shown for each site.

B. Implementation

The priority list should be used to develop an improvement schedule. The highest ranked site should be funded first and as funding becomes available, each site should be improved according to its respective rank.

If funds are not available to complete all improvements, traffic control device installation should be funded first. These are generally the most cost effective improvements and can be accomplished by the county maintenance crew. Widening, reconstruction or new construction improvements could be delayed until funding is available.

State law requires that all traffic control devices installed on the county road system conform to the standards set forth in the Manual on Uniform Traffic Control Devices for streets and highways (1978). The manual also specifies installation standards. By using uniform signs and markings and uniform placement, the driver becomes accustomed to obtaining clear information about the roadway by observing these devices.

TABLE 4

IMPROVEMENT PRIORITY LIST

<u>Priority</u> [*]	<u>Site No.</u>	<u>Location</u>	<u>Index</u>	<u>Cost</u>
1	1	Curve on Dry Creek Road 0.75 miles northeast of Montana Highway 200	72.84	\$1,730
2	2	Curve on Dry Creek Road 1.8 miles northwest of Montana Highway 200	71.74	\$ 860
3	3	Seven Mile Road overpass and I-94	67.24	\$1,340
4	4	Intersection of Michelle Lane and U.S. Highway 95 Business Route	65.88	\$ 585
5	5	Cutbacks on Makoshika State Park Road	58.25	<u>\$2,980</u>
Total cost				\$4,513 ^{**}

* Montana Department of Highway's Benefit/Cost Priorities are the same as the Priority Index Priorities.

** Not including Makoshika State Park Road.

New materials such as flexible delineators should be considered, especially in areas where delineators are subjected to repeated vehicular impacts.

In preparing this report, conversations with county road superintendents revealed that several counties have developed unique methods to carry out their county road programs. For example, in Valley County the road superintendent has developed a lay-down bridge end hazard marker post that is used on bridges where there is heavy farm equipment traffic. The county road superintendent in Custer County has a program for constructing precast bridge decks during the winter months.

An exchange of road construction and maintenance methods by counties throughout the state is a valuable source of information that may result in cost savings and statewide uniformity.

C. On-Going Program

The majority of the improvements recommended in this report are low cost and can be included in the county maintenance budget. Following implementation of the improvements, the annual county accident report provided by the Montana Department of Justice, Highway Traffic Safety Division, should be used to determine if a reduction of accidents at the improved locations has resulted. This will also enable the county road superintendent to determine the most effective safety improvements.

The accident cluster map which will be provided annually can be used to locate other high accident sites that can be targeted for future safety improvements.

The methods have been set forth in detail to enable the county to set up an on-going annual safety improvement schedule.

The following is a summary of the on-going safety improvement process:

1. Set up safety improvement schedule to implement recommended improvements set forth in this report, in order of priority and as funds become available.
2. Obtain annual plots of accidents occurring on county roads from the Montana Department of Justice, Highway Traffic Safety Division.
3. Use annual accident plots to evaluate effectiveness of safety improvements that have been implemented.
4. Use annual accident plots to determine high accident locations to be included in the on-going safety improvement program.
5. Obtain detailed accident reports for the selected sites from the Department of Justice.
6. Develop on-going improvement plan.

D. Funding Sources

The funding source for the recommended improvements will generally be from the county road budget. However, there are several state and federal programs that can be used to fund special improvements on off-system roads. These sources are described below:

- Bridge Replacement Program -- Fifteen percent of the federal funds received by the Montana Department of Highways for bridge replacement are allocated for the replacement of bridges on county off-system roads. Each county designates a priority bridge for replacement and funds are allocated according to need.
- Railroad Crossing Safety Funds -- The Montana Department of Highways rates all railroad crossings in the state according to the degree of hazard. This takes into account train volumes, vehicular traffic volumes, sight distance and other site characteristics. Funds are allocated statewide based on the hazard ratings.

- Coal Board Funds -- County roads directly impacted by coal extraction activities, may be eligible for funds from the State Coal Board.
- Coal Board Planning Funds -- Each county receives an annual allocation of planning funds from the State Coal Funds. These funds cannot be used for capital expenditures but are earmarked exclusively for planning activities. These funds could be used to carry out engineering studies for the on-going safety improvements program.
- Montana Department of Justice Safety Funds -- This project has been funded by the Montana Department of Justice, Highway Traffic Safety Division. The Division will continue to compile accident reports for each county. Some funding may be available to carry out the planning for the on-going safety improvement program.

The Highway Traffic Safety Division has also funded county road traffic counting programs by providing traffic counting equipment.

- Federal funding legislation allows the use of federal funds on off-system road improvements. In the future, these funds may be available through the Montana Department of Highways.

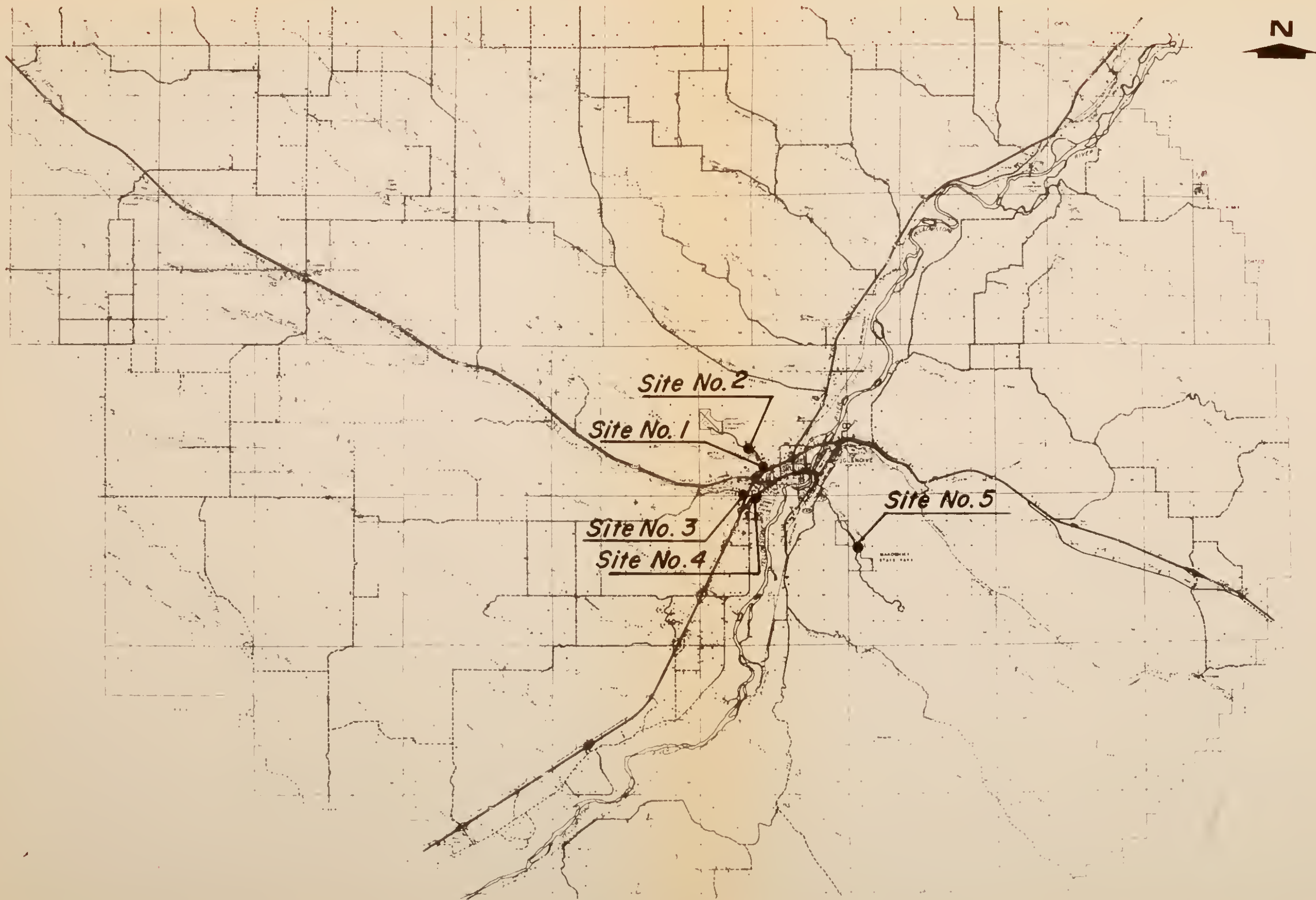
CHAPTER IV

SITE ANALYSIS

This chapter presents, in detail, the analysis of each of the sites.

The information for each site consists of the following:

1. General location map showing site locations within the county
2. Photos of the sites
3. Sketch plan showing existing conditions
4. Sketch plan showing recommended improvements
5. Accident summary
6. Hazard index and priority index calculations



SITE LOCATION MAP

Dawson County

*SITE NO.1 - CURVE ON DRY CREEK ROAD 0.75 MILES
NORTHEAST OF MONTANA HIGHWAY 200*



Southwest Approach



Mid - Curve

SITE #1
CURVE ON DRY CREEK ROAD 0.75 MILES
NORTHEAST OF MONTANA HIGHWAY 200 SOUTH

A. Description

This site is located on the county road leading to the Dawson Community Airport. Beginning at the intersection of Montana Highway 200 South, the road parallels Interstate 94, north right-of-way fence, then turns 90 degrees to a northwest direction.

The road is 26 to 28 feet in width with two 12-foot travel lanes and two 2-foot paved shoulders. The roadway has centerline and shoulder stripes. The curve is striped for no passing. The design speed for the curve is 18 miles per hours.

Traffic control at this location consists of 30-inch X 30-inch, W1-1 left and right curve signs on the approaches, three 48-inch X 24-inch, W1-6 large arrow signs located as shown on Figure 1-1, and a 24-inch X 30-inch, R2-1, 45 MPH speed limit sign for northbound traffic on the northwest approach. There is a 90-foot guard rail on the east side of the curve. Two private driveway approaches are located on the curve. The approach on the east side of the curve may give eastbound drivers the illusion that the road goes straight.

The road provides access to the surrounding residential area, scattered farms to the north and to Dawson Community Airport.

The estimated average daily traffic is 275 vpd on the southwest approach and 260 vpd on the northwest approach.

B. Accident Characteristics

Four reported accidents occurred at this site during the four-year period from 1979 through 1982. Two of the accidents occurred on

Wednesday and two on Saturday. There was no apparent monthly or seasonal pattern to the accidents, with the accidents equally distributed over spring, summer, fall and winter months. The accidents were also equally distributed directionally with two involving southbound vehicles and two eastbound vehicles. All accidents occurred during morning hours, one was at 3:30 AM and the remaining three occurred between the hours of 7:00 AM and 11:00 AM. Three of the accident occurred during daylight hours. The road condition was dry for three of the accidents and icy for the other. All accidents involved single vehicles leaving the roadway on the curve. One vehicle was a motorcycle. Two of the vehicles collided with a guardrail, one vehicle overturned. Speed was a contributing factor in three of the accidents. Two of the accidents resulted in injuries.

Figure 1-1 shows accident diagrams and Table 1-1 shows a summary of accident characteristics.

C. Evaluation

The following factors pertaining to the site were determined from the field survey and accident analysis.

1. Speed was a contributing factor in three of the four reported accidents.
2. The private driveway approach on the east side of the curve may give drivers the illusion that the road continues straight.
3. The existing guardrail has prevented two of the vehicles leaving the road from continuing on and possibly colliding with the residence on the east side of the curve.

D. Recommendations

The following improvements are recommended for this site. The improvements are shown on Figure 1-2.

1. Install bi-directional delineators on both sides of curve.
2. Install 18-inch X 24-inch, W1-8, chevron alignment signs on curve.
3. Install 18-inch X 18-inch, 15 MPH advisory speed plates on the existing turn sign posts.

E. Cost Estimates

<u>Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Install bi-directional delineators	27	ea.	\$ 20	\$ 540
Install approach delineators on driveway approach on west side of curve	2	ea.	\$ 20	\$ 40
Install 18"X24", W1-8, double alignment chevrons on curve	6	ea.	\$180	\$1,080
Install 18"X18", W13-1, 15 MPH advisory speed plates on existing turn sign posts	2	ea.	\$ 35	<u>70</u>
			Total cost	\$1,730

F. Hazard and Priority Indices

Based on the information collected and the foregoing analysis, the hazard index for this location is determined to be 65.78. The priority index is 72.84. The calculations are shown in Table 1-2.

Table 1-1

ACCIDENT SUMMARYSITE NUMBER 1 ACCIDENT PERIOD 1979 - 1982NUMBER OF ACCIDENTS
BY YEAR

1979	1980	1981	1982
1		1	2

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
			2			2

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
		1					1	1			1

-- AM --

NUMBER OF ACCIDENTS BY TIME OF DAY

-- PM --

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
		1				1		1		1													

NUMBER OF ACCIDENTS
BY LIGHT CONDITIONS

Day-light	Dark	Dawn	Dusk
3	1		

NUMBER OF ACCIDENTS
BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
3			1	

NUMBER OF ACCIDENTS
BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
4			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Object	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
			3				1		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Violat.	Drinking	Reckless Driving	Speed	Right-of-Way	Improper Passing	Improper Backing	Improper Turning	Other
			3					1

NUMBER OF ACCIDENTS BY SEVERITY

1979	1980	1981	1982
1			1
		1	1

Injury
Fatality
Property
Dam. OnlyNUMBER OF ACCIDENTS
ALCOHOL INVOLVED

0

Table 1-2

HAZARD INDEX CALCULATION

Site Number 1 Date January 1984

Site Description Curve on Dry Creek Road 0.75 miles northeast
of Montana Highway 200

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	<u>1.00</u> acc/yr	<u>25</u>	x 0.164 =	<u>4.10</u>
Accident Rate	<u>10.24</u> acc/MVE	<u>100</u>	x 0.225 =	<u>22.50</u>
Accident Severity	<u>12,300</u> dollars	<u>70</u>	x 0.191 =	<u>13.37</u>
Volume/Capacity Ratio	<u>0.04</u>	<u>15</u>	x 0.082 =	<u>1.23</u>
Sight Distance Ratio	<u>0.50</u> (wt.ave.)	<u>100</u>	x 0.074 =	<u>7.40</u>
Driver Expectancy	<u>4.50</u> (wt.ave.)	<u>76</u>	x 0.149 =	<u>11.32</u>
Information System Deficiencies	<u>3.00</u> (wt.ave.)	<u>51</u>	x 0.115 =	<u>5.86</u>

Hazard Index: 65.78

Cost of Recommended Improvements: \$1730

Cost Factor: 94

Priority Index = Hazard Index X .75 + Cost Factor X .25

$$\underline{65.78} \times .75 + \underline{94} \times .25 = \underline{72.84}$$

- LEGEND**
- ⊕ Power Pole
 - x- Wire Fence
 - 610 Average Daily Traffic
 - ┃ Delineator
 - ||— Guard Rail



SYMBOLS

- ← Moving Vehicle
- ←→ Backing Vehicle
- Pedestrian Path
- ▭ Parked Vehicle
- Fixed Object
- Fatal Accident
- Injury Accident

COLLISION TYPES

- ←→ Rear End
- ←→ Head On
- ←→ Side Swipe
- Out of Control
- ←→ Left Turn
- ←→ Right Angle

CONDITIONS

WEATHER:

F=Fog C=Clear R=Rain
S=Snow SL=Sleet

SURFACE: D=Dry W=Wet I=Icy

TIME → 1600 7/2/82 ← DATE
WEATHER → C D ← LIGHT
SURFACE

SCALE
100' 0 100' 200'

Existing Conditions & Accidents

SITE NO. 1
Dawson County

Fig. No.

1-1

CURVE ON DRY CREEK ROAD 0.75 MILES
NORTHEAST OF MONTANA HIGHWAY 200

Install W13-1, 18"x 18", 15 M.P.H.
Advisory Speed Plate On
Existing Turn Sign



- H = Bi-Directional
Delineators To Be Installed
- ⊕ = Existing Delineators
- ⊞ = Amber Approach Delineators
To Be Installed

SPEED
LIMIT
45

Maintain Existing Striping

Delineator Spacing
On Curve Is 25 Feet

Remove Existing
W1-6, Large Arrow Sign

Install 3- Double W1-8, 18"x24"
Chevron Alignment Signs
(Placement To Be Determined In Field)

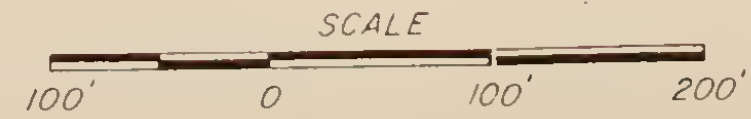


Remove Existing
W1-6, Large Arrow Sign

Install 3- Double W1-8, 18"x24"
Chevron Alignment Signs
(Placement To Be Determined In Field)



Install W13-1, 18"x 18", 15 M.P.H.
Advisory Speed Plate On
Existing Turn Sign



SITE NO. 1

Dawson County

Fig. No.
1-2

Recommended Improvements

CURVE ON DRY CREEK ROAD 0.75 MILES
NORTHEAST OF MONTANA HIGHWAY 200

***SITE NO. 2 - CURVE ON DRY CREEK ROAD 1.8 MILES
NORTHEAST OF MONTANA HIGHWAY 200***



East Approach



Northwest Approach

SITE 2
CURVES ON DRY CREEK ROAD 1.8 MILES
NORTHEAST OF MONTANA HIGHWAY 200 SOUTH

A. Description

This site is located on the county road leading to the Dawson Community Airport. The location is 2.2 road miles from the intersection of Montana Highway 200 South.

The road is 20 to 24 feet in width with a paved surface. Due to the width of the road, there is a centerline stripe with no shoulder stripes. There are two curves in the road, at this location. Approaching from the north, a hill crest hides the road alignment. The road is striped for no passing in the northbound direction on the east curve and no passing in either direction on the west curve. There is a school bus stop sign on the west approach. The bus stop area is located on the north side of the east curve, where a gravel turnout with a guardrail on the north side, has been constructed. The west curve has a radius of 670 feet and the east curve has a 740-foot radius. The superelevation on both curves is between three and four percent. The design speed for the west curve is 37 miles per hour.

The traffic on the road is generated by the airport and by scattered farmsteads on the areas to the north and west.

The estimated average daily traffic is 115 vpd.

B. Accident Characteristics

Three reported reported accidents occurred at this site during the four-year period from 1979 through 1982. Two accident occurred during the week and the other on Sunday. The three accidents occurred during

the months of January, June, and September. Two were during hours of darkness. The road condition was dry for two of the accidents and an icy road contributed to one accident. Speed was a possible violation in all three accidents. All of the accidents involved single vehicles leaving the road on a curve. Two of the accidents involved injuries.

Accident diagrams are shown on Figure 2-1. Table 2-1 summarizes accident characteristics at the site.

C. Evaluation

The following factors pertaining to the site were determined from the field survey and accident analysis.

1. Speed was a contributing factor in all three reported accidents.
2. The driver's view from the north approach is blocked by the crest of the hill.
3. There are no warning signs on the curve approaches.
4. The calculated design speed for the west curve is 37 MPH.

D. Recommendations

The following improvements are recommended for this site. The improvements are shown on Figure 2-2.

1. Install delineators on the south side of the west curve.
2. Install 30-inch X 30-inch, W1-4L, reverse turn signs with 18-inch X 18-inch, W13-1, 35 MPH advisory speed plates on the north and south approaches.
3. Install a 48-inch X 24-inch, W1-6, large arrow sign on the north approach.

E. Cost Estimates

<u>Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Install delineators	11	ea.	\$ 20	\$220
Install 30"X30", W1-4L, reverse turn signs with 18"X18", W13-1, 35 MPH advisory speed plates	2	ea.	\$215	\$430
Install 48"X24", W1-6, large arrow sign	1	ea.	\$210	<u>\$210</u>
			Total cost	\$860

F. Hazard and Priority Indices

Based on the information collected and the foregoing analysis, the hazard index for this location is determined to be 64.99. The priority index is 71.74. The calculations are shown in Table 2-2.

Table 2-1

ACCIDENT SUMMARYSITE NUMBER 2 ACCIDENT PERIOD 1979 - 1982NUMBER OF ACCIDENTS
BY YEAR

1979	1980	1981	1982
1	1		1

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
1			1		1	

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1					1			1			

-- AM --

NUMBER OF ACCIDENTS BY TIME OF DAY

-- PM --

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
			1							1										1			

NUMBER OF ACCIDENTS
BY LIGHT CONDITIONS

Day-light	Dark	Dawn	Dusk
1	2		

NUMBER OF ACCIDENTS
BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
2			1	

NUMBER OF ACCIDENTS
BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
3			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Object	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
							3		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Violat.	Drinking	Reckless Driving	Speed	Right-of-Way	Improper Passing	Improper Backing	Improper Turning	Other
			3					

NUMBER OF ACCIDENTS BY SEVERITY

1979	1980	1981	1982
	1		1
1			

Injury
Fatality
Property
Dam. OnlyNUMBER OF ACCIDENTS
ALCOHOL INVOLVED

0

Table 2-2

HAZARD INDEX CALCULATION

Site Number 2 Date January 1984

Site Description Curve on Dry Creek Road 1.8 miles northeast of
Montana Highway 200

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	<u>0.75</u> acc/yr	<u>17</u>	X 0.164 =	<u>2.79</u>
Accident Rate	<u>17.86</u> acc/MVE	<u>100</u>	X 0.225 =	<u>22.50</u>
Accident Severity	<u>12,400</u> dollars	<u>70</u>	X 0.191 =	<u>13.37</u>
Volume/Capacity Ratio	<u>0.03</u>	<u>12</u>	X 0.082 =	<u>0.98</u>
Sight Distance Ratio	<u>0.50</u> (wt.ave.)	<u>100</u>	X 0.074 =	<u>7.40</u>
Driver Expectancy	<u>4.00</u> (wt.ave.)	<u>68</u>	X 0.149 =	<u>10.13</u>
Information System Deficiencies	<u>4.00</u> (wt.ave.)	<u>68</u>	X 0.115 =	<u>7.82</u>

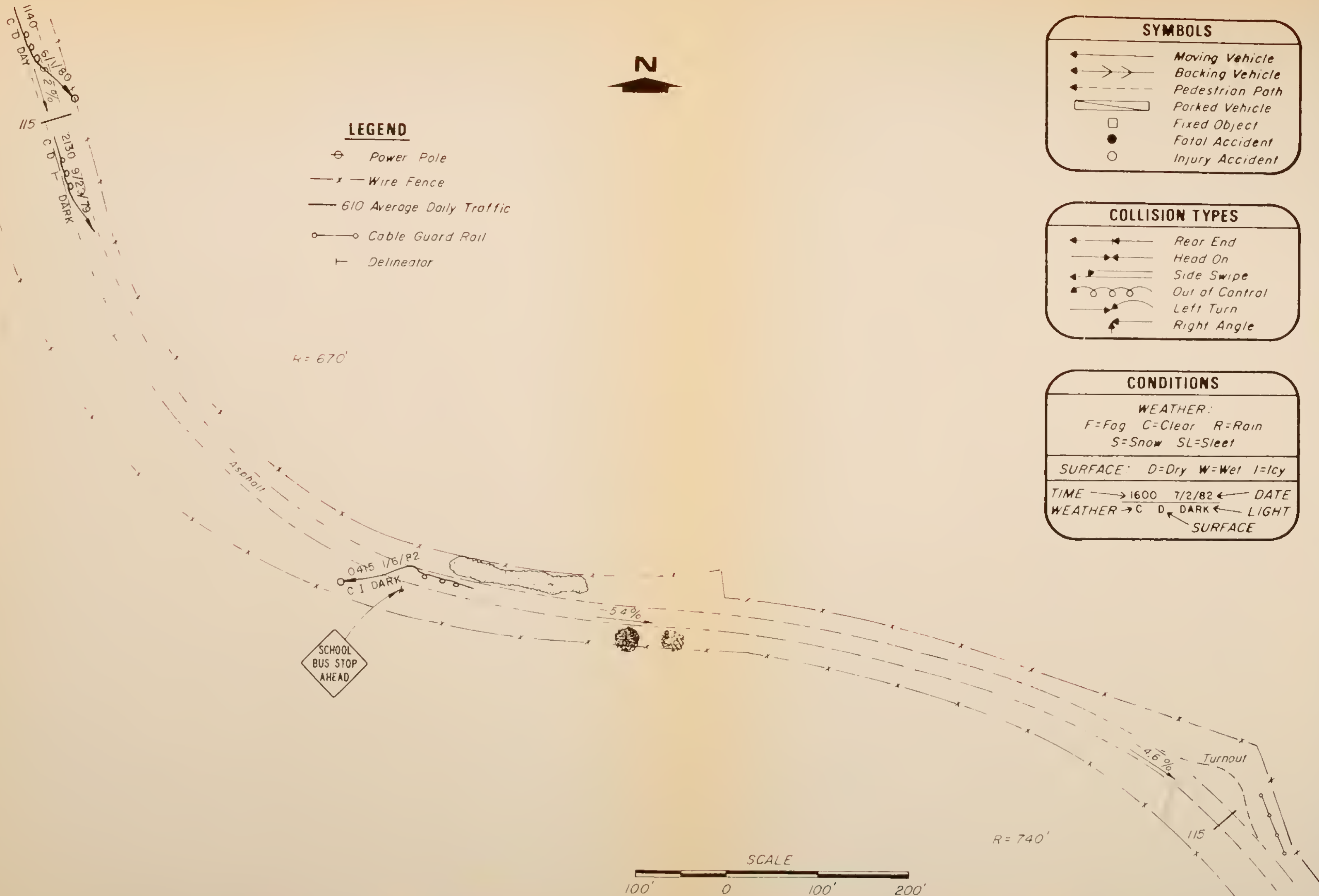
Hazard Index: 64.99

Cost of Recommended Improvements: \$860

Cost Factor: 92

Priority Index = Hazard Index X .75 + Cost Factor X .25

$$\underline{64.99} \times .75 + \underline{92} \times .25 = \underline{71.74}$$



Existing Conditions & Accidents

SITE NO. 2
Dawson County

Fig. No.
2-1

CURVE ON DRY CREEK ROAD 1.8 MILES
NORTHEAST OF MONTANA HIGHWAY 200

SITE NO. 3 - SEVEN MILE ROAD OVERPASS AT I-94



East Approach

SITE #3
SEVEN MILE ROAD OVERPASS AT I-94

A. Description

This site is located at the overpass of Seven Mile Road and Interstate Highway 94. The roadway is 28 feet in width with a paved surface. The 12-foot travel lanes are delineated with centerline and shoulder stripes. The pavement ends 810 feet west of the overpass. Slopes on the approaches to the overpass are one to two percent, however, they limit sight distance so that the roadway has been striped for no passing. Traffic control consists of a curve sign with a 30 mile per hour speed advisory plate for eastbound traffic on the east end of the site which references a left curve leading into the intersection of U.S. Highway 10, and a 35 mile per hour speed limit sign for westbound traffic on the west approach. Guardrail has been installed at both ends of the underpass.

The road provides access to the abutting residential area, the rodeo ground is a short cut between U.S. Highway 94 business route and Montana 200 South. The rodeo ground contributes to high, special event traffic volumes during the summer months. The estimated average daily traffic is 300 vpd.

B. Accident Characteristics

Two reported accidents occurred at this site during the four-year period from 1979 through 1982. Both accidents occurred during the week (Monday and Tuesday) and in the fall (October and November). One accident occurred during daylight hours in the afternoon, the other occurred in the early evening. Road and weather conditions were dry and clear during both accidents. Both accidents involved single vehicles leaving the road and overturning. Both accidents resulted in injuries. Speed was a contributing factor in both accidents.

Accident diagrams are shown on Figure 3-1. Table 3-1 summarizes accident characteristics at the site.

C. Evaluation

The following factors pertaining to the site were determined from the field survey and accident analysis.

1. Speed was a contributing factor in the two reported accidents at the site.
2. Observed speeds during the field survey appeared to be high considering the roadway characteristics.
3. The posted speed limit west of the overpass is 35 MPH, and the advised speed on the curve east of the underpass is 30 MPH.

D. Recommendations

The following improvements are recommended for this site. The improvements are shown on Figure 3-2.

1. Install delineators on both sides of roadway.
2. Install approach delineators at driveway and side road approaches.
3. Install 30-inch X 30-inch, W8-3, pavement ends sign on north side of west approach.
4. Install 12-inch X 36-inch, OM-3L and OM-3R, object markers at the four bridge ends.
5. Install 24-inch X 30-inch, R2-1, 35 MPH speed limit sign on the north side of the east approach.

E. Cost Estimates

<u>Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Install delineators on both sides of roadway	18	ea.	\$ 20	\$ 360
Install approach delineators	6	ea.	\$ 20	\$ 120
Install 30"X30", W8-3, pavement ends sign	1	ea.	\$180	\$ 180
Install 12"X36", OM-3L & OM-3R object markers	4	ea.	\$130	\$ 520
Install 24"X30", R2-1, 35 MPH speed limit sign	1	ea.	\$160	<u>160</u>
			Total cost	\$1,340

F. Hazard and Priority Indices

Based on the information collected and the foregoing analysis, the hazard index for this location is determined to be 57.99. The priority index is 67.24. The calculations are shown in Table 3-2.

ACCIDENT SUMMARYSITE NUMBER 3ACCIDENT PERIOD 1979 - 1982NUMBER OF ACCIDENTS
BY YEAR

1979	1980	1981	1982
	1	1	

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
	1	1				

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
									1	1	

-- AM --

NUMBER OF ACCIDENTS BY TIME OF DAY

-- PM --

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
												1					1						

NUMBER OF ACCIDENTS
BY LIGHT CONDITIONS

Day-light	Dark	Dawn	Dusk
1	1		

NUMBER OF ACCIDENTS
BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
1				

NUMBER OF ACCIDENTS
BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
1			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Object	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
			1				1		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Violat.	Drinking	Reckless Driving	Speed	Right-of-Way	Improper Passing	Improper Backing	Improper Turning	Other
			2					

NUMBER OF ACCIDENTS BY SEVERITY

1979	1980	1981	1982
	1	1	

Injury
Fatality
Property
Dam. Only

NUMBER OF ACCIDENTS
ALCOHOL INVOLVED

0

Table 3-2

HAZARD INDEX CALCULATION

Site Number 3 Date January 1984Site Description Seven Mile Road overpass and Interstate 94

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	<u>0.50</u> acc/yr	<u>13</u>	X 0.164 =	<u>2.13</u>
Accident Rate	<u>4.57</u> acc/MVE	<u>76</u>	X 0.225 =	<u>17.10</u>
Accident Severity	<u>12,400</u> dollars	<u>70</u>	X 0.191 =	<u>13.37</u>
Volume/Capacity Ratio	<u>0.04</u>	<u>15</u>	X 0.082 =	<u>1.23</u>
Sight Distance Ratio	<u>0.50</u> (wt.ave.)	<u>100</u>	X 0.074 =	<u>7.40</u>
Driver Expectancy	<u>3.50</u> (wt.ave.)	<u>60</u>	X 0.149 =	<u>8.94</u>
Information System Deficiencies	<u>4.00</u> (wt.ave.)	<u>68</u>	X 0.115 =	<u>7.82</u>

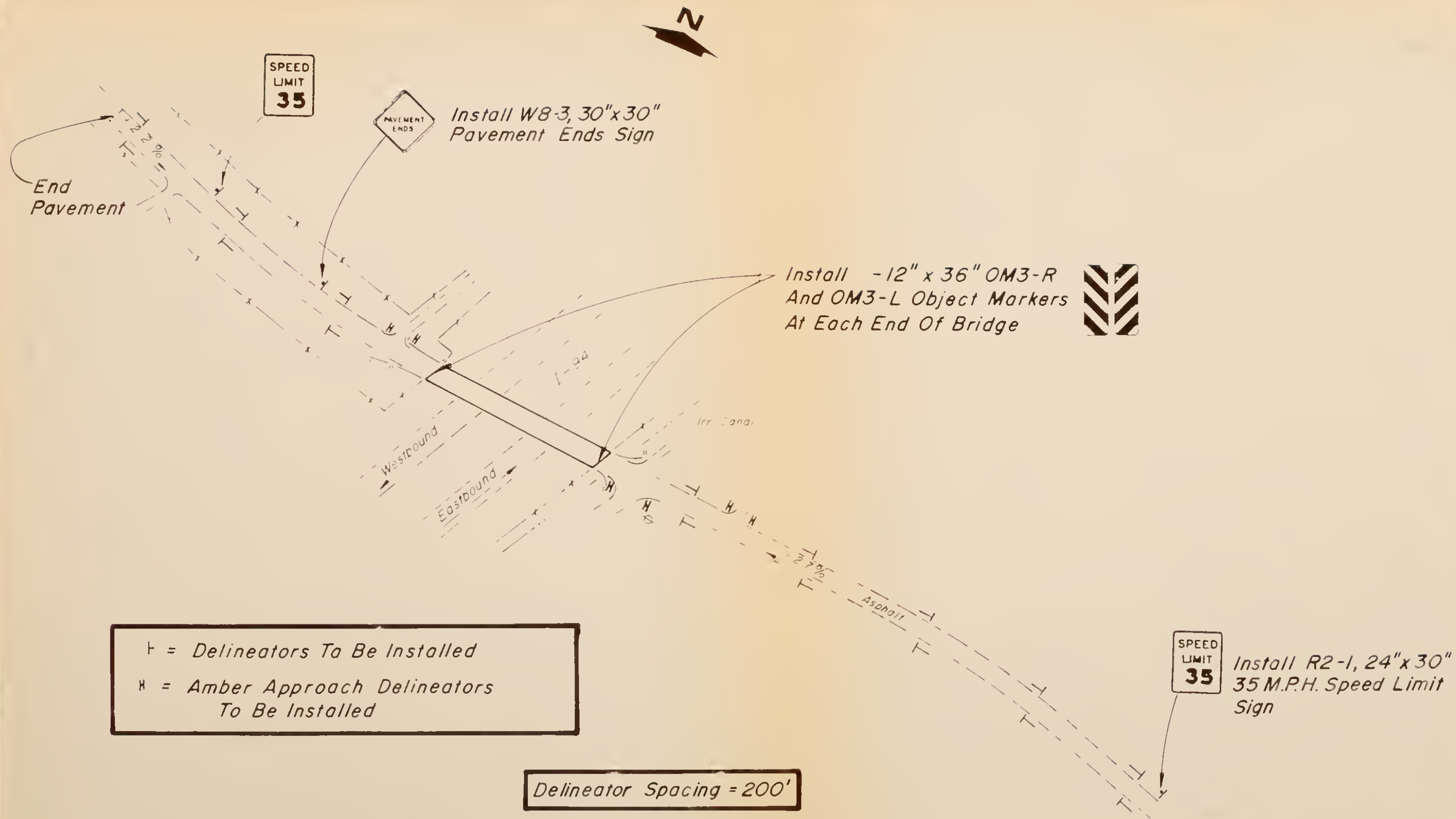
Hazard Index: 57.99Cost of Recommended Improvements: \$1340Cost Factor: 95

Priority Index = Hazard Index X .75 + Cost Factor X .25

$$\underline{57.99} \times .75 + \underline{95} \times .25 = \underline{67.24}$$



Existing Conditions & Accidents **SITE NO. 3** Dawson County



Recommended Improvements

SITE NO. 3
Dawson County

Fig. No.

3-2

SEVEN MILE ROAD OVERPASS AT I-94

**SITE NO. 4 - INTERSECTION OF SEVEN MILE CREEK ROAD
AND U.S. HIGHWAY 94 BUSINESS ROUTE**



Northeast Approach



South Approach



Southwest Approach

SITE #4
INTERSECTION OF MICHELLE LANE AND U.S.
HIGHWAY 94 BUSINESS ROUTE

A. Description

This site is the south approach of Michelle Lane and U.S. Highway 94 Business Route. It is located 1.86 miles southwest of the Glendive city limits. The roadway is 24 feet in width with a paved surface. The southwest approach of Michelle Lane is skewed at an angle causing a difficult angle of sight to the west. The approach angle also encourages westbound vehicles turning southwest to turn at high speeds. Traffic control on the southwest approach consists of a 35 mile per hour speed limit sign for southbound vehicles, a stop sign on the southwest approach and approach delineators on each side of the roadway. Striping has been worn off.

The road serves the residential area south of U.S. Highway 94 Business Route. The estimated average daily traffic on Michelle Lane is 560 vpd.

B. Accident Characteristics

Five reported accidents occurred at this site during the five-year period from 1979 through 1983. There is no apparent pattern by day of week or by month or season. Two of the accidents occurred on the weekend and three during the week. Three occurred during summer months and two during the winter. Three of the accidents occurred between the hours of 12:00 AM and 2:00 AM. Alcohol was a contributing factor in one of the accidents. Three accidents occurred during hours of darkness. The road condition was dry for three of the accidents and icy and snowpacked for the other two. Four of the accidents involved single vehicles leaving the roadway. Two of these vehicles collided with fixed

objects off the roadway, a mailbox and a power pole. Two of the collisions resulted in injuries. The three single vehicle accidents involved southbound vehicles. Excessive speed was a contributing factor in these accidents. The other two accidents involved vehicles failing to yield the right-of-way at the intersection.

Accident diagrams are shown on Figure 4-1. Table 4-1 summarizes accident characteristics at the site.

C. Evaluation

The following factors pertaining to the site were determined from the field survey and accident analysis.

1. Excessive speed contributed to accidents involving southbound vehicles at this site.
2. Sixty percent of the accidents were at night indicating the need for delineation.

D. Recommendations

The following improvements are recommended for this site. The improvements are shown on Figure 4-2.

1. Install 36-inch X 36-inch, W3-1, stop ahead sign on the southwest approach.
2. Install delineators on the northwest side of Michelle Lane at the intersection. Due to past experience of vehicles leaving the road at this point, it is suggested that flexible delineators be used to reduce replacement and maintenance costs.
3. Restripe the roadway including a stop line on the southwest approach.
4. Enforce speed limit.

5. Remove loose gravel on pavement on west approach radius at intersection.
6. If accidents continue to occur at this location, lighting of the intersection should be considered. The provision of a left turn bay for westbound traffic on U.S. Highway 94 Business Route should also be investigated for this intersection. These improvements should be done with state and federal funds as an improvement to the U.S. Highway 94 Business Route, a federal and primary highway.

E. Cost Estimates

<u>Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Install 36"X36", W3-1, stop ahead sign	1	ea.	\$225	\$585
Install flexible delineators	8	ea.	\$ 20	\$160
Restripe		lump sum		<u>\$200</u>
		Total cost		\$585

F. Hazard and Priority Indices

Based on the information collected and the foregoing analysis, the hazard index for this location is determined to be 54.50. The priority index is 65.88. The calculations are shown in Table 4-2.

Table 4-1

ACCIDENT SUMMARYSITE NUMBER 4ACCIDENT PERIOD 1979 - 1982NUMBER OF ACCIDENTS
BY YEAR

1979	1980	1981	1982-83
		1	4

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
1	1			1	1	1

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1					2	1					1

-- AM --

NUMBER OF ACCIDENTS BY TIME OF DAY

-- PM --

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	1							1							1								1

NUMBER OF ACCIDENTS
BY LIGHT CONDITIONS

Day-light	Dark	Dawn	Dusk
2	3		

NUMBER OF ACCIDENTS
BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
3		1	1	

NUMBER OF ACCIDENTS
BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
5			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Object	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
2			2				1		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Violat.	Drinking	Reckless Driving	Speed	Right-of-Way	Improper Passing	Improper Backing	Improper Turning	Other
	1		2	2				

NUMBER OF ACCIDENTS BY SEVERITY

1979	1980	1981	1982-83
			2
		1	2

Injury
Fatality
Property
Dam. OnlyNUMBER OF ACCIDENTS
ALCOHOL INVOLVED

1

Table 4-2

HAZARD INDEX CALCULATION

Site Number 4 Date January 1984Site Description Intersection of Michelle Lane and U.S. Highway94 Business Route

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	<u>1.25</u> acc/yr	<u>27</u>	X 0.164 =	<u>4.43</u>
Accident Rate	<u>6.12</u> acc/MVE	<u>93</u>	X 0.225 =	<u>20.92</u>
Accident Severity	<u>12,780</u> dollars	<u>71</u>	X 0.191 =	<u>13.56</u>
Volume/Capacity Ratio	<u>0.10</u>	<u>26</u>	X 0.082 =	<u>2.13</u>
Sight Distance Ratio	<u>2.00</u> (wt.ave.)	<u>0</u>	X 0.074 =	<u>0.00</u>
Driver Expectancy	<u>3.00</u> (wt.ave.)	<u>51</u>	X 0.149 =	<u>7.60</u>
Information System Deficiencies	<u>3.00</u> (wt.ave.)	<u>51</u>	X 0.115 =	<u>5.86</u>

Hazard Index: 54.50Cost of Recommended Improvements: \$585Cost Factor: 100

Priority Index = Hazard Index X .75 + Cost Factor X .25

$$\underline{54.50} \times .75 + \underline{100} \times .25 = \underline{65.88}$$

- ⊕ Power Pole
- x — Wire Fence
- 610 Average Daily Traffic
- M Amber Approach Delineator
- " — Guard Rail



Rear End
Head On
Side Swipe
Out of Control
Left Turn
Right Angle

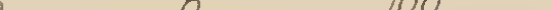
	Moving Vehicle
	Backing Vehicle
	Pedestrian Path
	Parked Vehicle
	Fixed Object
	Fatal Accident
	Injury Accident

WEATHER: F=Fog C=Clear R=Rain
S=Snow SL=Sleet

SURFACE: D=Dry W=Wet I=Icy

TIME → 1600 7/2/82 ← DATE
WEATHER → C D DARK ← LIGHT
SURFACE

SCALE



100' 0 100' 200'

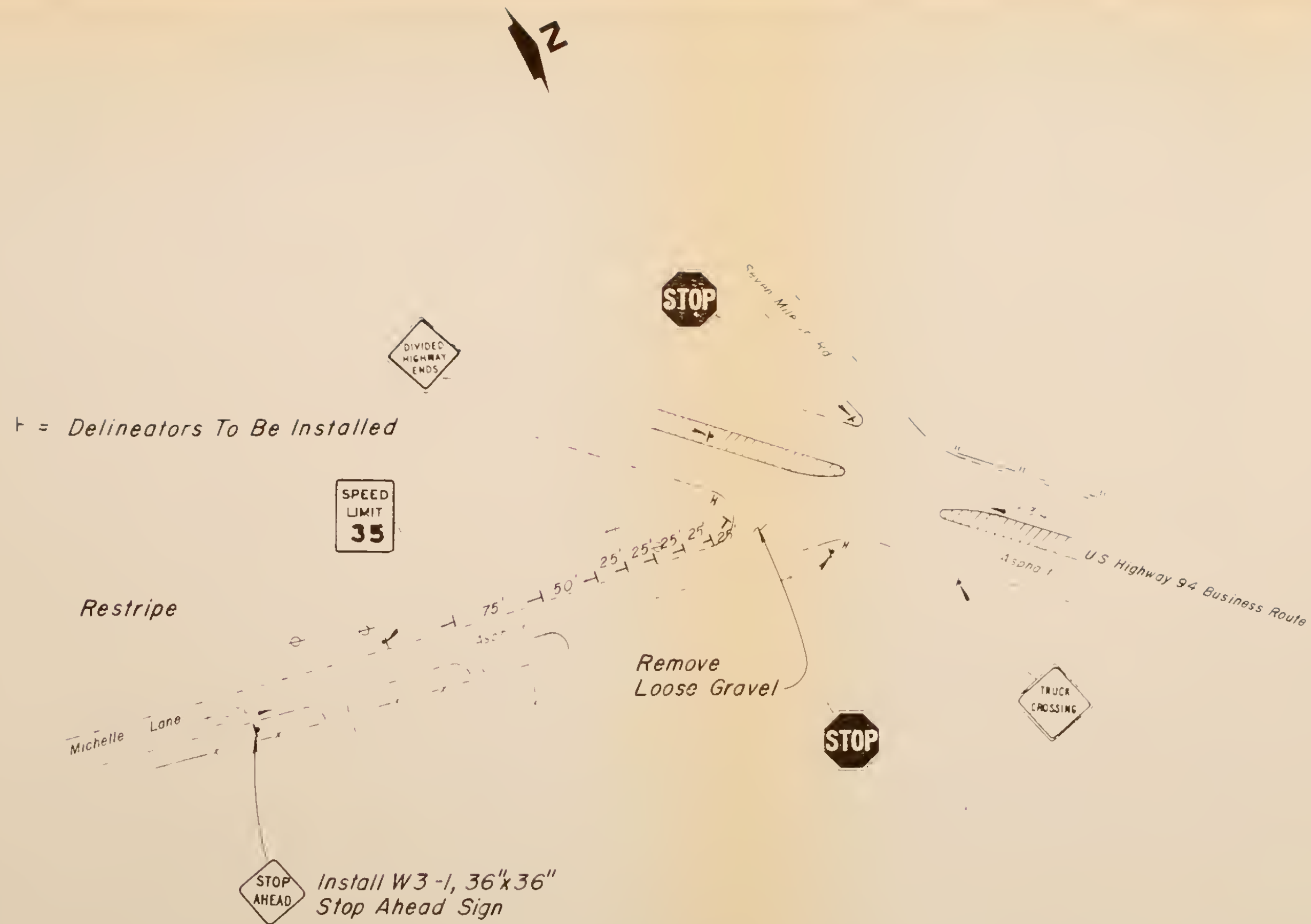
Existing Conditions & Accidents

INTERSECTION OF SEVEN MILE CREEK ROAD
AND U.S. HIGHWAY 94 BUSINESS ROUTE

SITE NO. 4
Dawson County

Fig. No.

4.1



Recommended Improvements

SITE NO. 4
Dawson County

INTERSECTION OF SEVEN MILE CREEK ROAD
AND U.S. HIGHWAY 94 BUSINESS ROUTE

Fig. No.

4-2

SITE NO.5 - CUTBACKS ON MAKOSHIKA STATE PARK ROAD



Hairpin Curve

SITE #5
CUTBACKS ON MAKOSHICA STATE PARK ROAD

A. Description

This site is a series of hairpin curves on the Makoshika State Park Road, approximately 2.5 miles southeast of the Glendive city limits. Improvements of this site is the responsibility of the State of Montana, Department of Fish, Wildlife and Parks. The road is 22 to 28 feet wide. There are intermittent paved and gravel sections, with pavement on some of the curves (see Figure 5-1). The site is located on a section of road that has two sharp hairpin curves. The road has an average grade of 9.5 percent from the south end of the site to the north end, a distance of approximately 2,550 feet. During the field survey, the following roadway characteristics were observed:

1. Due to the steep slope, gravel from the unpaved section washes onto the paved sections creating a "ball-bearing" effect, which may make the friction factor of the paved sections less than that of the gravel sections.
2. Sheet drainage across the road creates washboarding, the natural material on the shoulders is subject to erosion.
3. Traffic on this road is seasonal, during the field survey in November, traffic was estimated at 20 vpd. An average, annual volume of 150 vpd is estimated, taking into consideration the average, year-around use.
4. Many of the drivers during the peak traffic periods are unfamiliar with the road.

B. Accident Characteristics

Three accidents occurred at this site during the four-year period from 1979 through 1982. In addition, five accidents were reported from 1975 through 1978, including one fatality. The locations of the three diagrammed accidents (Figure 5-1) are estimated because all vehicles had

been removed when the investigating officer arrived. All three accidents involved single vehicles leaving the road on the curves due to excessive speed. Two of the accidents occurred during the weekend. The accidents occurred in the months of January, March and November. All accidents were during hours of darkness, one in the early evening and two in the early morning hours. Road and weather conditions were dry and clear.

Table 5-1 summarizes accident characteristics at the site.

C. Evaluation

The following factors pertaining to the site were determined from the field survey and accident analysis.

1. Excessive speed and unfamiliarity with the road were contributing factors in the reported accidents.
2. All reported accidents occurred at night indicating the need for delineation.
3. Roadway characteristics contributing to accidents include loose gravel on gravel sections and on paved sections and washboarding due to sheet drainage across the roadway.

D. Recommendations

The following improvements are recommended for this site. The improvements are shown on Figure 5-2.

1. Install bi-directional delineators on the outside of the curves. It is recommended that flexible delineators be used due to condition of the existing delineators which indicates a high number of collisions.
2. Install 36-inch X 36-inch, W1-5L, winding road signs on the north and south approaches.
3. Install 36-inch X 36-inch, W1-5aR and W10-5aL, hairpin curve signs on the uphill approaches to the two hairpin curves.

4. Install 18-inch X 24-inch, W1-8 double chevron on the two hairpin curves.
5. Pave existing gravel sections -- this is a long range improvement and is not included in the priority ranking computation.

E. Cost Estimates

<u>Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Total Cost</u>
Install bi-directional delineators	50	ea.	\$ 20	\$ 1,000
Install 36"X36", W1-5L, winding road signs	2	ea.	\$225	\$ 450
Install 36"X36", W1-5aR & W105aL, hairpin curve signs	2	ea.	\$225	\$ 450
Install 18"X24", W1-8, double chevron signs	6	ea.	\$180	\$ 1,080
Pave existing gravel sections*	4,670	s.y.	\$ 17	<u>\$79,390</u>
			Total cost	\$ 2,980

F. Hazard and Priority Indices

Based on the information collected and the foregoing analysis, the hazard index for this location is determined to be 58.33. The priority index is 58.25. The calculations are shown in Table 5-2.

*Major long range improvement, not included in priority ranking computations.

ACCIDENT SUMMARY

SITE NUMBER 5 ACCIDENT PERIOD 1979 - 1982NUMBER OF ACCIDENTS
BY YEAR

1979	1980	1981	1982
	2	1	

NUMBER OF ACCIDENTS BY DAY OF WEEK

Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
1			1			1

NUMBER OF ACCIDENTS BY MONTH

Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1		1								1	

-- AM --

NUMBER OF ACCIDENTS BY TIME OF DAY

-- PM --

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	1		1																1				

NUMBER OF ACCIDENTS
BY LIGHT CONDITIONS

Day-light	Dark	Dawn	Dusk
	3		

NUMBER OF ACCIDENTS
BY ROAD CONDITIONS

Dry	Wet	Snow	Ice	Other
3				

NUMBER OF ACCIDENTS
BY WEATHER CONDITIONS

Clear	Rain	Snow	Fog
3			

NUMBER OF ACCIDENTS BY ACCIDENT TYPE

Angle	Turn	Rear End	Fixed Object	Ped.	Animal	Side-swipe	Non-Col	Head-on	Backing
							3		

NUMBER OF ACCIDENTS BY POSSIBLE VIOLATION

No Violat.	Drinking	Reckless Driving	Speed	Right-of-Way	Improper Passing	Improper Backing	Improper Turning	Other
			3					

NUMBER OF ACCIDENTS BY SEVERITY

1979	1980	1981	1982
	2		
		1	

Injury
Fatality
Property
Dam. OnlyNUMBER OF ACCIDENTS
ALCOHOL INVOLVED

0

Table 5-2
HAZARD INDEX CALCULATION

Site Number 5 Date January 1984

Site Description Cutbacks on Makoshika State Park Road

Indicator	Data Value	Indicator Value	Weight	Partial H.I.'s
Number of Accidents	<u>0.75</u> acc/yr	<u>17</u>	X 0.164 =	<u>2.79</u>
Accident Rate	<u>13.70</u> acc/MVE	<u>100</u>	X 0.225 =	<u>22.50</u>
Accident Severity	<u>12,400</u> dollars	<u>70</u>	X 0.191 =	<u>13.37</u>
Volume/Capacity Ratio	<u>0.03</u>	<u>12</u>	X 0.082 =	<u>0.98</u>
Sight Distance Ratio	<u>1.50</u> (wt.ave.)	<u>10</u>	X 0.074 =	<u>0.74</u>
Driver Expectancy	<u>4.00</u> (wt.ave.)	<u>68</u>	X 0.149 =	<u>10.13</u>
Information System Deficiencies	<u>4.00</u> (wt.ave.)	<u>68</u>	X 0.115 =	<u>7.82</u>

Hazard Index:	<u>58.33</u>
Cost of Recommended Improvements:	<u>\$2,980</u>
Cost Factor:	<u>58</u>

Priority Index = Hazard Index X .75 + Cost Factor X .25

$$\underline{58.33} \times .75 + \underline{58} \times .25 = \underline{58.25}$$

- LEGEND**
- ⊕ Power Pole
 - Existing Pavement
 - 610 Average Daily Traffic
 - M Amber Approach Delineator

Large Boulders

Toe of Slope



SYMBOLS

- ← Moving Vehicle
- ← → Backing Vehicle
- Pedestrian Path
- ▬ Parked Vehicle
- Fixed Object
- Fatal Accident
- Injury Accident

COLLISION TYPES

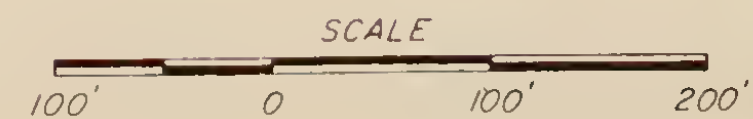
- ← → Rear End
- ← → Head On
- ← → Side Swipe
- ← → Out of Control
- ← → Left Turn
- ← → Right Angle

CONOITIONS

WEATHER:
 F=Fog C=Clear R=Rain
 S=Snow SL=Sleet

SURFACE: D=Dry W=Wet I=Icy

TIME → 1600 7/2/82 ← DATE
 WEATHER → C D DARK ← LIGHT
 SURFACE



Existing Conditions & Accidents

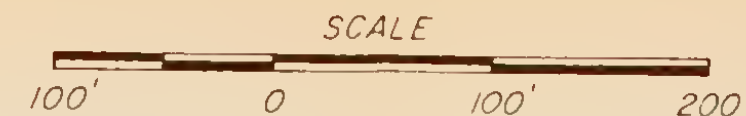
CUTBACKS ON MAKOSHKA STATE PARK ROAD

SITE NO. 5
Dawson County

Fig. No.
5-1



Install WI-5L, 30"x30"
Winding Road Sign
(Placement To Be Determined In Field)



Delineator Spacing
On Curve Is 30 Feet

Remove Existing Delineators

Bi-Directional
H = Delineators To Be Installed

Install 2 - Double WI-8, 18"x24"
Chevron Alignment Signs
(Placement To Be Determined In Field)

Install 2 - Double WI-8, 18"x24"
Chevron Alignment Signs
(Placement To Be Determined In Field)



Large
Boulders

Delineator Spacing
On Curve Is 25 Feet

Delineator Spacing
On Curve Is 30 Feet

Delineator Spacing
On Curve Is 30 Feet

Toe of
Slope



Install WI-5L, 30"x30"
Winding Road Sign
(Placement To Be Determined In Field)



Install WI-5aL, 36"x36"
Hairpin Curve Sign

Install 2 - Double WI-8, 18"x24"
Chevron Alignment Signs
(Placement To Be Determined In Field)



Recommended Improvements

SITE NO. 5

Dawson County

CUTBACKS ON MAKOSHKA STATE PARK ROAD

Fig. No.

5-2

Wilson Jones ® Made in U.S.A.

C447-13 Redi-Cover		UPC
C447-13	RED	44712
C447-13B	BLACK	44753
C447-13BL	DARK BLUE	44761
C447-13J	LIGHT BLUE	44760
C447-13Y	YELLOW	44710

